A Hitherto Unrecorded Midge Gall of *Myrsine australis* (A. Rich.) Allan

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STEM GALLS on *Myrsine australis* were reported by Lamb (1960) in his checklist of New Zealand Zoocecidea, but there appears to be no record yet of the conspicuous bud galls (Fig. 1) found near the branch extremities of this handsome tree, which is readily recognized by its red, mottled leaves, red stems, and dark red bark (Allan, 1961). When cut open, the dark bud galls may be seen to contain small white midge larvae or pupae in various stages of metamorphosis.

The present report is concerned chiefly with anatomical modifications of the leaf bud by the midge larvae.

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METHODS AND MATERIALS

Galls of *Myrsine australis* were examined on trees in the forest over a period of 16 months, and specimens for histological examination were fixed in Formo-acetic-alcohol. Serial sections were cut at 10μ and stained in Safranin and Fast Green (Johansen, 1940). Freehand sections of living galls were made to observe the details of nutritive tissue which is slightly distorted by the fixative.

Pupae were removed from galls and left in small stoppered glass vials to transform into adult midges.

Artificial formation of the galls was attempted by removing small larvae from galls and placing them on tender buds of stem cuttings. The cuttings were kept under bell jars in the south light of the laboratory window, with the base of the cuttings immersed in tap water in small flasks.

OBSERVATIONS

New galls were first apparent in December as dull olive-green, budlike structures (Fig. 1).

FIG. 1. Bud galls of *Myrsine australis*.

Within two months they had become almost black outwardly, masking the chlorophyll and red pigmentation of the internal tissues. During a mild spell of weather in winter, a few additional young galls were formed in June, but this would seem to be an exceptional event.

Under natural conditions in the forest, galls appear to live 10–12 months. By the following spring most galls are shrivelled and dry.

Mature galls range from 1/4 to 3/4 inch in length. Frequently the terminal gall of a branchlet may dominate the subjacent lateral galls (Fig. 2).

The midge larvae are small and white with prominent salivary glands containing polytene banded chromosomes. The larvae transform within the gall into small black pupae with prominent eyes which are crimson at first and

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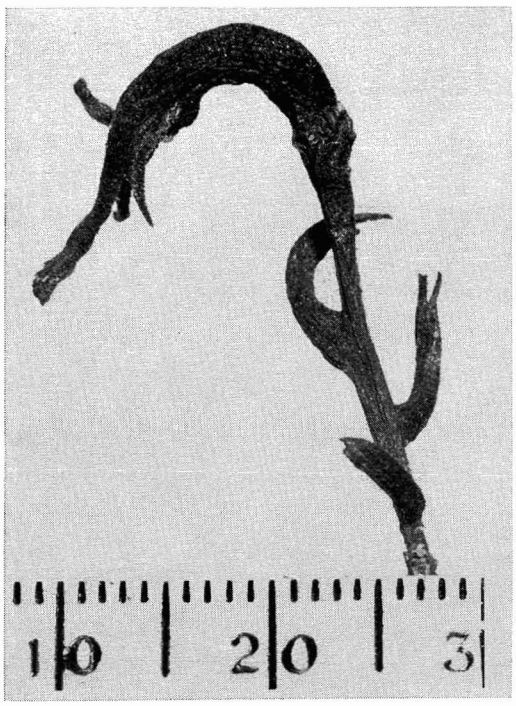

FIG. 2. Large terminal gall and three smaller galls.

later dark purple. The adult fly is shining black with simple, fragile wings.

In the laboratory some flies emerged in autumn, probably in response to the high indoor temperatures.

When young larvae were removed from galls and placed on the soft tips of new shoots in the laboratory, they made no attempt to enter the new host plant. (In other experiments by the author with the gall moth *Morova subfasciata* Walk., the larval insect was capable of re-entering new shoots of the host after removal from the galls.) The attempt to elicit new galls on *Myrsine australis* with living larvae of the midge was unsuccessful, therefore.

It is readily apparent that each gall is composed of two or three modified leaves which are fused together.

A trace of the leaf blades may be seen at the top of the gall. Evidently the gall is derived chiefly from swollen petioles, which are curved and fused together to form a small urnlike structure occupied by one or more larvae.

There is some variation in the degree of fusion of the modified leaves which form the walls of the gall. Where the leaf margins are merely closely pressed together, a boundary is recognizable; in other cases the cells of each contributing swollen leaf are completely interknit, leaving no demarcation.

Some galls are partitioned into two compartments, and others contain only a single loculus. The number of larvae per gall ranges from one to four, the larger galls generally containing more larvae than the smaller ones.

In living galls the vaselike cavity is lined by nutritive tissue which may bear finger-like cells

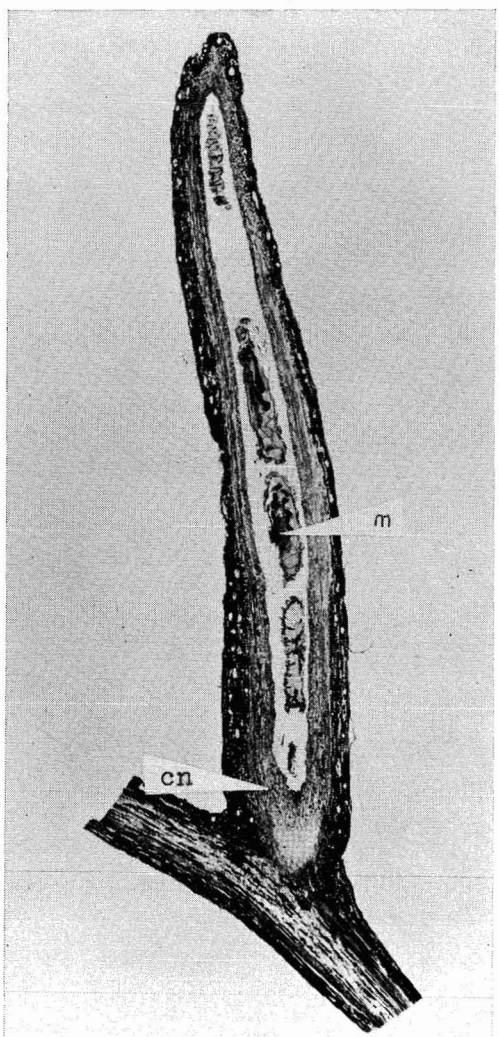

FIG. 3. Longitudinal section through a large gall. *cn,* Chlorophyllous nutritive parenchyma; *m,* midge larva.

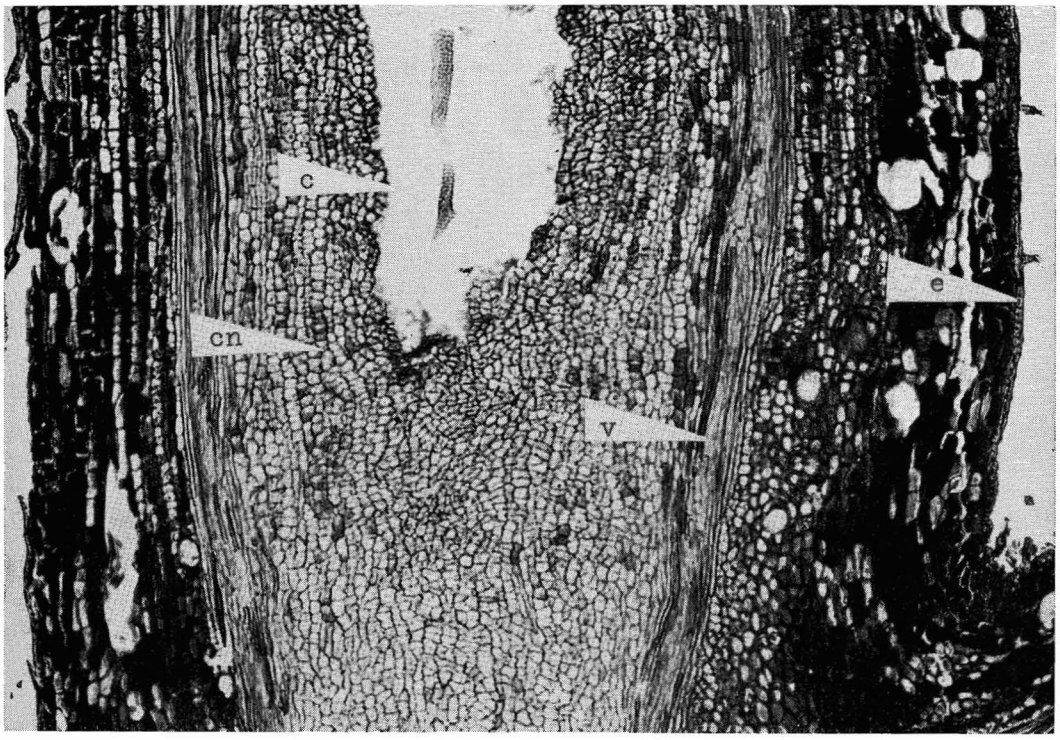

FIG. 4. Detail of Figure 3. *v,* Vascular strand; *cn,* chlorophyllous nutritive tissue; *c,* larval cavity; *e,* epidermis of gall.

projecting inwards. The concave base of the cavity is composed of chlorophyllous nutritive parenchyma (Fig. 3) which continues to multiply as the larvae feed. This growth ceases soon after the larvae discontinue feeding.

No remnant is left of the shoot apical meristem which originally gave rise to the two or three primordial leaves. In the development of galls at stem tips, increase in length of the branch is therefore curtailed at the same time as the leaf primordia are converted, under the influence of the larvae, into a gall.

The internal anatomy of the gall is rather more stemlike than leaflike, lacking as it does the characteristic stomatal arrangement and associated organisation of palisade layers and spongy mesophyll.

A very prominent cuticle extends over the gall epidermis and is continuous with the equally thick cuticle of the normal epidermis of the supporting stem.

Apart from the nutritive tissue surrounding the larvae, the histological features of the galls are the same as are found in the normal stem, namely: red pigmented cells, secretory cells, schizogenous cavities and canals with yellow or reddish brown contents, and normal vascular tissue (Metcalfe and Chalk, 1950).

DISCUSSION

A study of the life cycle of the gall midge was not undertaken, and the record of emergence of adult flies in autumn in the laboratory appears to be unseasonal, and related to higher average temperatures than those prevailing out of doors.

It would seem that the main morphogenetic changes accompanying gall formation are a suppression of the activity of the marginal meristems of the leaf primordia togteher with the eventual destruction of the shoot apical meristem from which the leaf primordia arose. There is evidence of limited growth of the leaf apex.

The bulk of the tissue appears to be con-

tributed by the swollen and fused petioles. These leaf parts are the nearest to the larva which occupies the former site of the shoot growing point.

Substances emanating from the larva might tend to stimulate growth in basal parts of a rudimentary leaf and these regions might undergo cell division and growth at the expense of other parts of the unformed leaves. Fusion of the basal parts of rapidly multiplying leaf primordia could readily occur, assisted possibly by wound hormones and larval secretions. These would be free to operate without the overriding influence of the shoot apical meristem.

In paraffin sections stained in Safranin and Fast Green, the salivary glands of larvae show characteristic giant cells with banded polytene chromosomes.

The synthetic activities of the salivary gland cells not only may assist feeding of the larvae but also may provide the secretions which are responsible for the transformation of presumptive leaf primordia to galls (Mani, 1964).

SUMMARY

A bud gall of *Myrsine australis* (A. Rich.) Allan caused by a gall midge is reported for the first time.

The galls are composed of modified leaves which form the walls of an urnlike structure enclosing the midge larvae or pupae.

The larvae feed on proliferating chlorophyllous tissue which lines the larval cavity.

During the development of the gall from a shoot bud, the apical meristem is destroyed by the larvae, and the leaf rudiments undergo transformation and fusion.

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